***Weather Questions:***

1. **If peak solar radiation occurs around noon, why is it that the highest recorded temperature of the day doesn’t occur until almost 4 pm?**

***Answer:***

***During the course of the day, the surface of the Earth is heated by the sun. As the radiation from the sunlight decreases, the surface slowly releases the heat stored to the air above. The air temperature increases until the heat stored and being released by the surface decreases.***

**2)Almost all of the energy used on Earth to sustain life and cause our changing weather systems comes from the Sun. When the electromagnetic waves from the Sun reach Earth, some are reflected off the atmosphere and clouds back into space; some pass through the atmosphere and bounce off Earth’s surface back into the atmosphere; and some get absorbed by the atmosphere, the ground, or the water at the surface. In the Northern Hemisphere, the summer solstice - the day with the most hours of daylight or the peak of solar energy input - is around June 21, yet the hottest days of the year usually do not occur until late July.**

**Using the words “heat capacity”, explain why there is a delay between the peak solar radiation of the year (the most hours of sunlight) and the highest temperatures of the year.**

***Answer:***

***Water has a very high heat capacity and takes a long time to heat up. On a global scale, the heat released from the water will warm the air above it and this warmer air circulates. Air temperatures will not start to decrease until the heat released by the water decreases.***

***3)* A sample of water and a sample of soil were placed under a lamp for 20 minutes. After 10 minutes the lamp was turned off and the temperature of each sample continued to be taken for the next 10 minutes. The graph below shows the temperature of each sample over time.**

**A) Which sample would act as a better heat sink (better able to absorb heat and store energy)?**

**B) Which sample has a higher heat capacity (requires more energy to heat up)?**

***Answers:***

***A) Water is a better heat sink.***

***B) Water has a higher heat capacity.***

**4)On a clear day, solar energy heats the land and water, which absorb the energy; the energy is converted into heat and warms the air that comes into contact with it. The warm air expands, becomes less dense (or more buoyant) and has less pressure. The less dense air rises and is replaced by cooler, denser air that has more pressure, setting up a convection current. When this occurs near a sea, an ocean or a lake, it is called a sea breeze or a land breeze.**

**1) The sun has been shining on the water and land all morning. Draw a diagram to show the direction of the convection current, i.e. in which direction the cooler, denser air is moving and where the warmer air is moving.**

**2) It is late in the evening. Draw a diagram to show the direction of the convection current.**

**Answer: See** Text p. 553

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**5) Humidity is the measure of the amount of water vapour in the atmosphere. It affects the weather as well as how comfortable we feel. Low humidity means evaporation can occur from bodies of water and other sources. High humidity means that clouds or fog may form, and those that have formed will persist rather than evaporate. Look at Figure 1 on page 558 of the textbook. This graph shows the amount of water vapour 1 kg of dry air has to contain at different temperatures to reach 100% humidity.**

**1) Why does condensation form on the windows inside of your house on very cold days during the winter?**

**2) Why is it so hard to cool off on a very hot, humid summer day?**

**3) Based on your knowledge of humidity and the behaviour of air at different temperatures, explain how you would decrease the relative humidity.**

***Answers***

***1) Inside the house, the level of moisture in the air is usually higher than outside on a very cold day, and the windows are cooler than the air in the rooms. When the warmer air touches the cold window, the particles lose energy, cool down and the water vapour condenses on the window.***

***2) The air contains limited amounts of water vapour. The amount depends on temperature. On hot, humid days, if the air is saturated or close to being saturated with water vapour, it will not be able to absorb the water vapour released upon perspiration. Normally, our body’s cooling is a result of perspiration evaporating from our skin since evaporation requires energy (think about the water cycle and the Changing States of Water activity). The energy for evaporation comes from the surrounding area, such as skin and the air, and the process cools the surrounding area (i.e. your skin).***

***3) To remove moisture from the air, lower the temperature of the air so the air particles have less energy and condensation occurs.***

**6) On a warm spring day you get caught in the rain and your jacket is completely soaked. There is no clothes dryer to be found. Describe what you would do to get your jacket to dry as fast as possible. Why?**

***Answer***

***The fastest way to get something to dry is to spread it out or hang it up to increase the surface area from which evaporation can occur and to use a fan or put the shirt in a windy place, since the wind blows away the air moistened by evaporation and brings drier air - which encourages further evaporation. If possible, further reducing the humidity of the surrounding air and increasing the temperature would ideal. If the surrounding air is close to its water vapour saturation point, the rate of evaporation will be slower. Also, the ability of air to hold water vapour increases with temperature.***

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**7)A student who lives on the south coast of New Zealand places a message in a bottle, seals the bottle, and throws it into the coastal waters. About 4 years later, another student finds the same bottle floating in the ocean off the coast of Iceland. Use the diagram on page 525 to describe how this is possible. Include the names of the ocean currents as well as the continents that the bottle passed on its route to Iceland.**

***Answer***

***This question is taken from p. 527 of the textbook, section 13.9 “Ocean Currents”. The answer can be found on p. 4-46 of the Teacher’s Guide.***

**8) The water and land cool the air above them. This creates large masses of air with roughly the same temperature and moisture content. These air masses extend for hundreds of kilometers and are often classified according to the region that produced them. For example, air which sits in the Arctic for a few months during the dark days of the polar winter turns cold and dry like the snow and ice below it. Meteorologists may call this an Arctic air mass. Similarly, air which sits above the Gulf of Mexico or the Caribbean Sea during the summer months becomes warm and moist. This type of air mass is often called tropical.**

**The weather would be easy to forecast if these air masses stayed in one place, but they do not. They move, pushed by the circulation of the air in the upper reaches of the troposphere. A front is a boundary or transition zone between an air mass, which is entering a region, and the air mass, which is leaving it. These two air masses usually have quite different characteristics which may result in very dramatic changes in weather.**

**Imagine that over New Brunswick, there is a tropical air mass. An air mass originating in the Arctic is moving into the province.**

**1) Which air mass would have a higher pressure?**

**2) Describe what will happen to the warmer tropical air as the colder air mass moves in (think about air and density and the water cycle).**

**3) What would you expect to see on a satellite picture? A radar picture?**

***Answers***

***1) The Arctic air mass will have higher pressure since it contains colder air. This means the particles are moving more slowly, are closer together and denser.***

***2) The warmer tropical air will be pushed up by the colder, denser air. As the warmer air rises, it will cool and the water vapour will condense.***

***3) The clouds over New Brunswick would likely be moving counterclockwise around the centre of the low while the clouds coming into New Brunswick with the arctic high pressure would be moving clockwise. The clouds would also thicken as the two systems met. On the IR satellite images, the colours would move towards red showing the changes in temperature of the cloud tops. As the air is pushed up, the clouds could continue to grow vertically. On the radar, there would be an indication of precipitation appearing or intensifying shown by a change of colours.***

***9)*During an extreme El Niño, the fishing industry in Peru, located on the west coast of South America does poorly, but fishers off the west coast of North America report catching fish never before seen there.**

**1) Draw a diagram that shows the effects of El Niño on the convection pattern normally seen over the Pacific Ocean.**

**2) Using your understanding of convection, explain why fish would move northward from the coast of South America to the west coast of North America.**

***Answers:***

***This question is adapted from text p. 615, questions 2 and 5.***

**1) *See text p. 613 for a diagram.***

**2) *Fish that normally thrive in the cold ocean current off the coast of Peru and other parts of South America move away when the warmer El Niño currents arrive. Since the ocean waters are cooler farther from the equator, many fish move northward to areas along the west coast of North America. (Taken from Teacher’s Guide p. 4-177, question 5.)***

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